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How to cite:

Curtis-Harper, Elliot; Olsson-Francis, Karen; Schwenzer, Susanne and Pearson, Victoria (2015). The anaerobic community of an estuarine environment: an analogue for life on Mars. In: 4th UK in Aurora Programme Meeting, 15 May 2015, London.

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Version: Version of Record

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The anaerobic community of an estuarine environment: an analogue for life on Mars.

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In this study, we used microbiological techniques in combination with several analytical geochemical techniques to identify potential biomarkers for life on Mars. A community of anaerobic microorganisms containing chemolithoautotrophs was isolated from below the redox potential discontinuity (RPD) layer. The anaerobic conditions, the 11-15 ˚C temperature and high salinity (37 g l^{-1} NaCl) make the sub-RPD zone an ideal environment to sample a biological analogue for the martian subsurface. Samples were collected from the River Dee estuary, UK, for use in this study.

Anaerobic growth experiments were conducted using a water-based minimal growth medium containing sodium lactate (carbon source), ammonium chloride (nitrogen source), and thioglycollate and ascorbic acid (reducing sources). Bioessential elements were provided by a Mars analogue substrate consisting of a mix of non-amygdaloidal terrestrial basalt and aegirine, an iron rich silicate. The experiments were carried out under a representative Mars gas headspace and buffered using sodium bicarbonate.

Direct cell counts demonstrated that the microbial community could grow by utilising the Mars analogue as their only source of bioessential minerals. The dissolution kinetics were determined from the concentration of key elements (such as Si, Ca, K, Fe) in the growth medium measured by ICP-AES. Gas chromatography was carried out on aliquots of the headspace gas to measure the concentration of methane, which is a byproduct of methanogen metabolism. Preliminary comparisons of headspace methane in biotic and abiotic replicates suggest abiotic production of methane to be significant in this system.

The results from this study demonstrate that a mixed community of anaerobic microorganisms can be supported nutritionally by the release of bioessential minerals from a Mars analogue substrate under a compositionally accurate martian atmosphere. Future work will analyse the elements released during biotic and abiotic dissolution and investigate the precipitation of secondary minerals during these experiments, since these may be indicative of processes that could elucidate biomarkers for life detection on Mars.